TRANSPORTATION IMPACT ASSESSMENT

PROPOSED RESIDENTIAL DEVELOPMENT
2 PRESCOTT STREET & 39 LINCOLN STREET
READING, MASSACHUSETTS

Prepared for:

NEWMEADOW DEVELOPMENT, LLC
Newton, Massachusetts

October 2015

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EXECUTIVE SUMMARY

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a 77-unit residential apartment community to be located at 2 Prescott Street and 39 Lincoln Street in Reading, Massachusetts (hereafter referred to as the "Project"). This assessment was prepared in consultation with the Town of Reading and the Massachusetts Department of Transportation (MassDOT); was performed in accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*; and was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports. Based on this assessment, we have concluded the following with respect to the Project:

1. Using trip-generation statistics published by the Institute of Transportation Engineers (ITE)[1] and without reduction to account for public transportation utilization, the Project is predicted to generate approximately 590 vehicle trips on an average weekday (two-way, 24-hour volume), with 41 vehicle trips expected during the weekday morning peak-hour and 60 vehicle trips expected during the weekday evening peak-hour;

2. The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions);

3. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study intersections; and

4. Lines of sight to and from the Project site driveway intersections with Prescott Street and Lincoln Street were found to exceed the required minimum distance for the intersections to function in a safe manner based on the appropriate approach speed along both roadways with the removal of on-street parking adjacent to the driveways.

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

[1] *Trip Generation*, 9th Edition; Institute of Transportation Engineers; Washington, DC; 2012.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of a full-access driveway that will intersect the south side of Prescott Street west of Lincoln Street and a one-way exit driveway that will intersect the west side of Lincoln Street. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The full access Project site driveway should be a minimum of 24-feet in width and accommodate two-way traffic. If a marked centerline is to be provided, it should consist of a double-yellow line in accordance with that the centerline pavement marking standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[2]

- The one-way exit Project site driveway should be a minimum of 16-feet in width and include appropriate signs ("One-Way", "Do Not Enter", etc.) and pavement markings to reinforce the one-way operation of the driveway.

- Vehicles exiting the Project site should be placed under STOP-sign control with a marked STOP-line provided.

- All signs and pavement markings to be installed within the Project site shall conform to the applicable standards of the MUTCD.

- Sidewalks should be provided within the Project site linking the proposed buildings and other amenities to the sidewalk infrastructure along Prescott Street and Lincoln Street.

- Marked crosswalks and wheelchair ramps should be provided for crossing the Project site driveways and at pedestrian crossings within the Project site.

- Signs and landscaping to be installed along the Project site driveways, internal to the Project site and at the Project site driveway intersections with Prescott Street and Lincoln Street should be designed and maintained so as not to restrict lines of sight.

- Snow windrows along the Project site frontage on Prescott Street and Lincoln Street within the sight triangle areas of the Project site driveways shall be promptly removed where such accumulations would exceed 2.5 feet in height.

- On-street parking should be prohibited for a minimum distance of 20-feet on either side of the Project site driveways in order to provide and maintain the required lines of sight for the driveways to operate in a safe manner.

- A school bus waiting area should be provided at an appropriate location designated by the Town.

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[2] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

Transportation Demand Management

The Project site is ideally situated to take advantage of available public transportation opportunities, including Commuter Rail service at Reading Station which is located opposite the Project site. In an effort to the encourage use of alternative modes of transportation to single-occupant vehicles, the following Transportation Demand Management (TDM) measures will be implemented as a part of the Project:

- Information regarding public transportation services, maps, schedules and fare information will be posted in a central location;
- A "welcome packet" will be provided to new residents of the Project detailing available public transportation services, bicycle and walking alternatives, and commuter options available through MassRIDES' and their NuRide program which rewards individuals that choose to walk, bicycle, carpool, vanpool or that use public transportation to travel to and from work;
- Pedestrian accommodations will be incorporated within the Project site consisting of sidewalks and pedestrian paths linking buildings and parking to on-site amenities;
- A mail drop will be provided in a central location; and
- Secure bicycle parking will be provided, including both exterior bicycle racks adjacent to building entrances and weather protected bicycle parking in a secure area within the parking garage.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a residential community to be located at 2 Prescott Street and 39 Lincoln Street in Reading, Massachusetts (hereafter referred to as the "Project"). This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Prescott Street and Lincoln Street, as well as at the intersections of Prescott Street at Washington Street; Prescott Street at Lincoln Street; and Lincoln Street at Washington Street and Minot Street.

PROJECT DESCRIPTION

As proposed, the Project will entail the construction of a 77-unit residential apartment community to be situated on two parcels of land located at 2 Prescott Street and 39 Lincoln Street in Reading, Massachusetts, that will be combined into a single parcel. When combined, the Project site will encompass approximately 0.83 acres of land bounded by Prescott Street and a commercial property to the north; residential properties to the south; Lincoln Street and commercial properties to the east; and residential properties to the west. Figure 1 depicts the Project site location in relation to the existing roadway network. At present, the Project site contains two commercial buildings and associated appurtenances that will be removed in conjunction with the Project.

Access to the Project site will be provided by way of a full-access driveway that will intersect the south side of Prescott Street west of Lincoln Street and a one-way exit driveway that will intersect the west side of Lincoln Street.

Figure 1

Site Location Map

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STUDY METHODOLOGY

This study was prepared in consultation with the Town of Reading and the Massachusetts Department of Transportation (MassDOT); was performed in accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines* and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A seven-year time horizon was selected for analyses consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in October 2015. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the Project was selected to contain the major roadways providing access to the Project site including Prescott Street and Lincoln Street, as well as the intersections of Prescott Street at Washington Street; Prescott Street at Lincoln Street; and Lincoln Street at Washington Street and Minot Street.

The following describes the study area roadways and intersections.

Roadways

Prescott Street

- Two-lane roadway under Town jurisdiction
- Traverses study area in a general northeast-southwest direction
- Provides two 15 to 16-foot wide travel lanes separated by a double-yellow centerline with no marked shoulders provided
- A sidewalk is provided along both sides of the roadway
- "Share the Road" signs are present to designate share use of the roadway by bicycles and motor vehicles
- Illumination is provided by way of street lights mounted on wood poles
- "Prima facie" speed limit is 30 miles per hour (mph)[3]
- Land use consists of the Project site and residential and commercial properties

Lincoln Street

- Two-lane roadway under Town jurisdiction
- Traverses study area in a general northwest-southeast direction

[3]The "prima facie" speed is defined in M.G.L. Chapter 90, Section 17, as the speed which would be deemed reasonable and proper to operate a motor vehicle.

- Provides two 12 to 22-foot wide travel lanes separated by a double-yellow centerline with no marked shoulders
- On-street parking is permitted along the east side of the roadway north of Washington Street
- A sidewalk is provided along one or both sides of the roadway
- "Prima facie" speed limit is 30 mph
- Illumination is provided by way of street lights mounted on wood poles
- Land use consists of the Project site, commercial and residential properties, and Reading Station on the Haverhill Branch of the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail system

Intersections

Table 1 and Figure 2 summarize lane use, traffic control, and pedestrian and bicycle accommodations at the study area intersections as observed in October 2015.

Table 1
STUDY AREA INTERSECTION DESCRIPTION

Intersection	Traffic Control Type[a]	No. of Travel Lanes Provided	Shoulder Provided? (Yes/No/Width)	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/Description)
Prescott Street/ Washington Street	S	1 per direction on Prescott Street and Washington Street north of Prescott Street; Washington Street south of Prescott Street is one-way southbound	No	Yes – both sides of Prescott Street and west side of Washington Street; Crosswalks across Washington Street (both sides) and Prescott Street west leg; school zone crossing signs are posted for crossing Prescott Street	Yes - Shared travelled-way on Prescott Street and Washington Street south of intersection[b]
Prescott Street/ Lincoln Street	S	1 per direction on both roadways	No; on-street parking permitted along east side of Lincoln Street	Yes – both sides of Prescott Street and Lincoln Street north of Prescott Street; Crosswalks across Prescott Street and north leg of Lincoln Street (2 separate crosswalks)	Yes - Shared travelled-way on Prescott Street and Lincoln Street south of intersection
Lincoln Street/ Washington Street/ Minot Street	S	1 per direction on Lincoln Street, Minot Street and Washington Street east of intersection; Washington Street is one-way eastbound west of intersection	1-foot shoulders on Washington Street east of intersection; on-street parking permitted along east side of Lincoln Street	Yes – east side of Lincoln Street, south side of Washington Street west of intersection, both sides of Minot Street and Washington Street east of intersection; Crosswalk across Lincoln Street/Washington Street	Yes - Shared travelled-way on Lincoln Street and Washington Street

[a]TS = traffic signal control; S = STOP-sign control; Y = YIELD-sign control; R = rotary/roundabout control; NC = no control present.
[b]Combined shoulder and travel lane width equal to or exceed 14 feet.

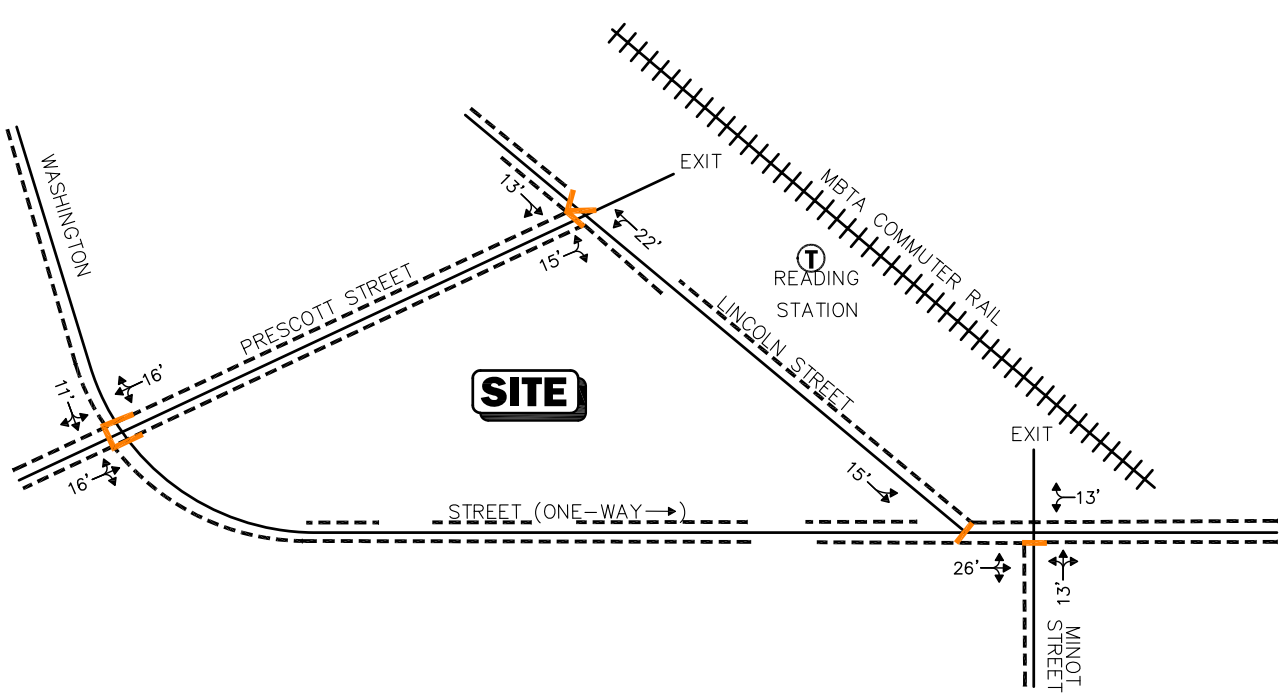

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Figure 2

Existing Intersection
Lane Use and Travel Lane Width

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EXISTING TRAFFIC VOLUMES

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in October 2015 while public schools were in regular session. The ATR counts were conducted on Prescott Street and Lincoln Street in the vicinity of the Project site in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for both the Project and the adjacent roadway network.

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Group 6 roadways (urban arterials, collectors and rural arterials) were reviewed.[4] Based on a review of this data, it was determined that traffic volumes for the month of October are approximately 7.0 percent above average-month conditions and, therefore, were not adjusted downward in order to provide a conservative (above-average) analysis condition. The 2015 Existing traffic volumes are summarized in Table 2, with the weekday morning and evening peak-hour traffic volumes graphically depicted on Figure 3. Note that the peak-hour traffic volumes presented in Table 2 were obtained from the TMCs and are reflected on the aforementioned figure.

Table 2
2015 EXISTING TRAFFIC VOLUMES

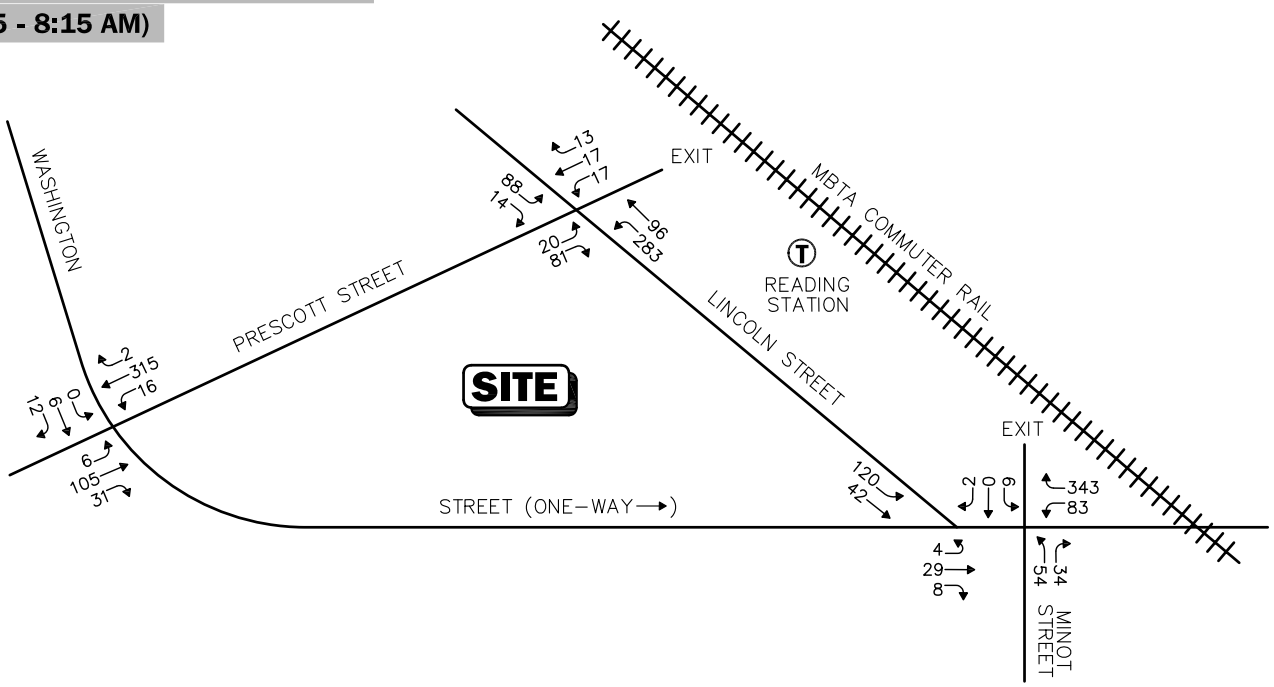
		Weekday Morning Peak-Hour (7:15 – 8:15 AM)			Weekday Evening Peak-Hour (4:30 – 5:30 PM)		
Location	AWT[a]	VPH[b]	K Factor[c]	Directional Distribution	VPH	K Factor	Directional Distribution
Prescott Street, west of Lincoln Street	3,760	415	11.0	75.7% WB	404	10.7	60.1% EB
Lincoln Street, south of Prescott Street	4,795	565	11.8	67.1% NB	492	10.3	63.2% SB

[a]Average weekday traffic in vehicles per day.
[b]Vehicles per hour.
[c]Percent of daily traffic occurring during the peak-hour.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

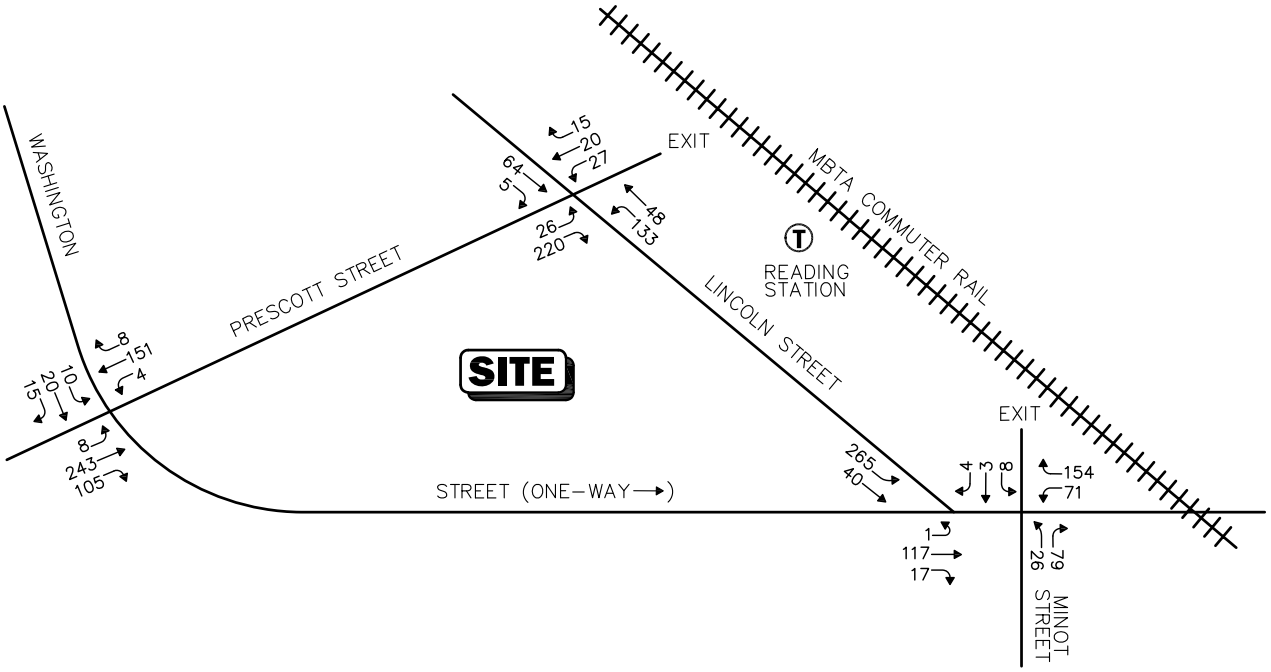
As can be seen in Table 2, Prescott Street in the vicinity of the Project site was found to accommodate approximately 3,760 vehicles on an average weekday (two-way, 24-hour volume), with approximately 415 vehicles per hour (vph) during the weekday morning peak-hour and 404 vph during the weekday evening peak-hour.

[4]MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2011 Weekday Seasonal Factors, Group 6 – Urban Arterials, Collectors and Rural Arterials.

WEEKDAY EVENING PEAK HOUR
(7:15 - 8:15 AM)



WEEKDAY EVENING PEAK HOUR
(4:30 - 5:30 PM)



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 3

2015 Existing
Peak Hour Traffic Volumes

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Lincoln Street in the vicinity of the Project site was found to accommodate approximately 4,795 vehicles on an average weekday, with approximately 565 vph during the weekday morning peak-hour and 492 vph during the weekday evening peak-hour.

PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in October 2015. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. As detailed on Figure 2, sidewalks are currently provided along one or both sides of the study area roadways, with marked crosswalks provided at the study intersections. We note that the sidewalk along Washington Street between Prescott Street and Lincoln Street is intermittent along its alignment. Wheelchair ramps and tactile panels are provided at the pedestrian crossings within the study area.

Formal bicycle facilities were not identified within the study area; however, Prescott Street, Washington Street east of Prescott Street, and Lincoln Street south of Prescott Street, provide sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration.[5] In addition, "Share the Road" signs are posted along Prescott Street within the study area.

PUBLIC TRANSPORTATION

Public transportation services are provided within the study area by the MBTA. Reading Station on the Haverhill Branch of the MBTA Commuter Rail system is located immediately adjacent to the Project site at the intersection of Lincoln Street at Prescott Street, and provides service to North Station in Boston. In addition, at Reading Station, the MBTA operates fixed-route bus service by way of Route 136/137, *Reading Depot – Malden Station*, which provides service from Reading Station to Wakefield Square, Franklin Square, Oak Grove Station and Malden Station, with Oak Grove Station and Malden Station providing connections to the MBTA Orange Line subway system. The closest stop to the Project site for the Route 136/137 bus is located at the Lincoln Street/Prescott Street intersection, also immediately adjacent to the Project site. The public transportation schedules and fare information is provided in the Appendix.

As detailed in the preceding section, the Project site is linked to the aforementioned public transportation services by way of sidewalks along Prescott Street and Lincoln Street, with marked crosswalks provided for crossing Lincoln Street at its intersection with Prescott Street.

[5] A minimum combined travel lane and paved shoulder width of 14-feet is required to support bicycle travel in a shared travelled-way condition.

SPOT SPEED MEASUREMENTS

Vehicle travel speed measurements were performed on Prescott Street and Lincoln Street in the vicinity of the Project site over a continuous 48-hour period (Tuesday through Wednesday, inclusive) in conjunction with the ATR counts. Table 3 summarizes the vehicle travel speed measurements.

Table 3
VEHICLE TRAVEL SPEED MEASUREMENTS

	Prescott Street		Lincoln Street	
	Eastbound	Westbound	Northbound	Southbound
Mean Travel Speed (mph)	25	26	25	23
85th Percentile Speed (mph)	29	30	30	28
Posted Speed Limit (mph)	--[a]	--[a]	--[a]	--[a]

[a]Speed limit is not posted.
mph = miles per hour.

As can be seen in Table 3, the mean (average) vehicle travel speed along Prescott Street in the vicinity of the Project site was found to be approximately 26 mph. The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 30 mph. The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

The mean vehicle travel speed along Lincoln Street in the vicinity of the Project site was found to be approximately 24 mph, with the average measured 85th percentile vehicle travel speed found to be approximately 29 mph.

Given that a speed limit is not posted on Prescott Street or Lincoln Street, the "prima facie" speed limit pursuant to M.G.L. Chapter 90 Section 17 would be 30 mph given the nature of the abutting land use (thickly settled or business district).[6]

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent five-year period available (2009 through 2013, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, and day of occurrence, and presented in Table 4.

[6]The "prima facie" speed is defined in M.G.L. Chapter 90, Section 17, as the speed which would be deemed reasonable and proper to operate a motor vehicle.

Table 4
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Prescott Street/ Washington Street	Lincoln Street/ Prescott Street	Lincoln Street/ Washington Street/ Minot Street
Traffic Control Type:[b]	U	U	U
Year:			
2009	0	0	0
2010	1	0	0
2011	0	0	0
2012	0	1	0
2013	0	0	1
Total	1	1	1
Average	0.20	0.20	0.20
Rate[c]	0.09	0.09	0.06
MassDOT Crash Rate:[d]	0.60/0.58	0.60/0.58	0.60/0.58
Significant?[e]	No	No	No
Type:			
Angle	1	0	1
Rear-End	0	0	0
Head-On	0	0	0
Sideswipe	0	0	0
Fixed Object	0	0	0
Pedestrian/Bicycle	0	1	0
Unknown/Other	0	0	0
Total	1	1	1
Day of Week:			
Monday through Friday	1	1	1
Saturday	0	0	0
Sunday	0	0	0
Total	1	1	1
Severity:			
Property Damage Only	1	1	1
Personal Injury	0	0	0
Fatality	0	0	0
Total	1	1	1

[a]Source: MassDOT Safety Management/Traffic Operations Unit records, 2009 through 2013.
[b]Traffic Control Type: U = unsignalized; TS = traffic signal.
[c]Crash rate per million vehicles entering the intersection.
[d]Statewide/District crash rate.
[e]The intersection crash rate is significant if it is found to exceed the MassDOT crash rate for the MassDOT Highway Division District in which the Project is located (District 4).

As can be seen in Table 4, the study area intersections were found to have experienced an average of less than one (1) reported motor vehicle crash per year over the five-year review period, and all were found to have a motor vehicle crash rate below both the MassDOT statewide and District averages for an unsignalized intersection for the MassDOT Highway Division District in which the intersections are located (District 4). In addition, no fatal motor vehicle crashes were reported to have occurred at the study area intersections over the five-year review period. ***Based on a review of the MassDOT motor vehicle crash data, no discernible safety deficiencies were apparent at the study intersections.*** The detailed MassDOT Crash Rate Worksheets are provided in the Appendix.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2022, which reflects a seven-year planning horizon consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. Independent of the Project, traffic volumes on the roadway network in the year 2022 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2022 No-Build traffic volumes reflect 2022 Build traffic volume conditions with the Project.

FUTURE TRAFFIC GROWTH

Future traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

Specific Development by Others

The Reading Planning Department website was reviewed in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on this review, the following projects were identified that may result in an increase in traffic within the study area:

- ***Reading Woods, Reading, Massachusetts.*** This project will entail the construction of a 424 unit residential condominium community to be located off Jacob Way in Reading, Massachusetts. This project is currently under construction.

- ***Criterion Children Enrichment Facility, Reading, Massachusetts.*** This project consists of the construction of an 8,460 square foot (sf) day care center to be located at 186-190 Summer Avenue in Reading, Massachusetts.

Traffic volumes associated with the aforementioned specific development projects by others were obtained from the respective traffic studies or using trip-generation information available from the Institute of Transportation Engineers (ITE)[7] for the appropriate land use, and were assigned onto the study area roadway network based on existing traffic patterns where no other information was available. No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data and the growth rate used in another traffic study performed in the area,[8] a 1.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

MassDOT and the Town of Reading Department of Public Works were contacted in order to determine if there were any planned future roadway improvement projects expected to be complete by 2022 within the study area. Based on these discussions, no roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

The 2022 No-Build condition peak-hour traffic-volumes were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2015 Existing peak-hour traffic volumes and then superimposing the peak-hour traffic volumes associated with the identified specific development projects by others. The resulting 2022 No-Build weekday morning and evening peak-hour traffic volumes are shown on Figure 4.

PROJECT-GENERATED TRAFFIC

Design year (2022 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadways. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

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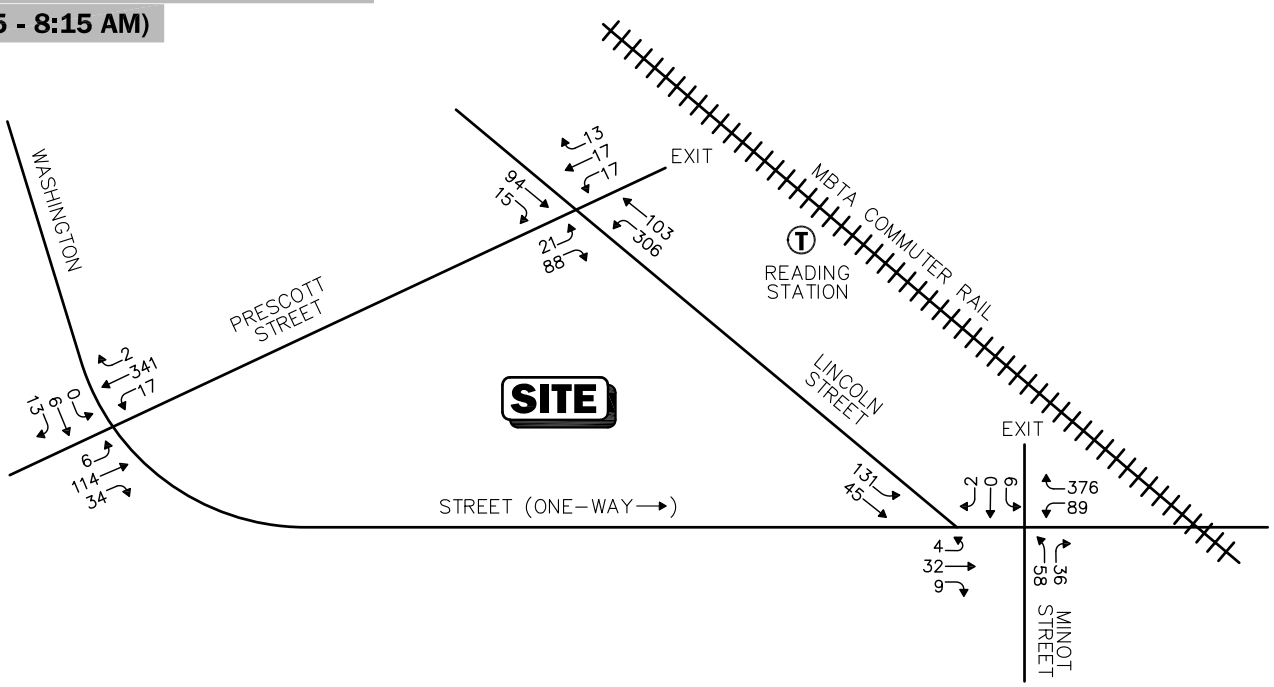
[7] Ibid 1

[8] *Traffic Impact and Access Study*, Reading Woods, Reading, Massachusetts; Dermot J. Kelly Associates, Inc.; December 2010.

WEEKDAY EVENING PEAK HOUR
(7:15 - 8:15 AM)



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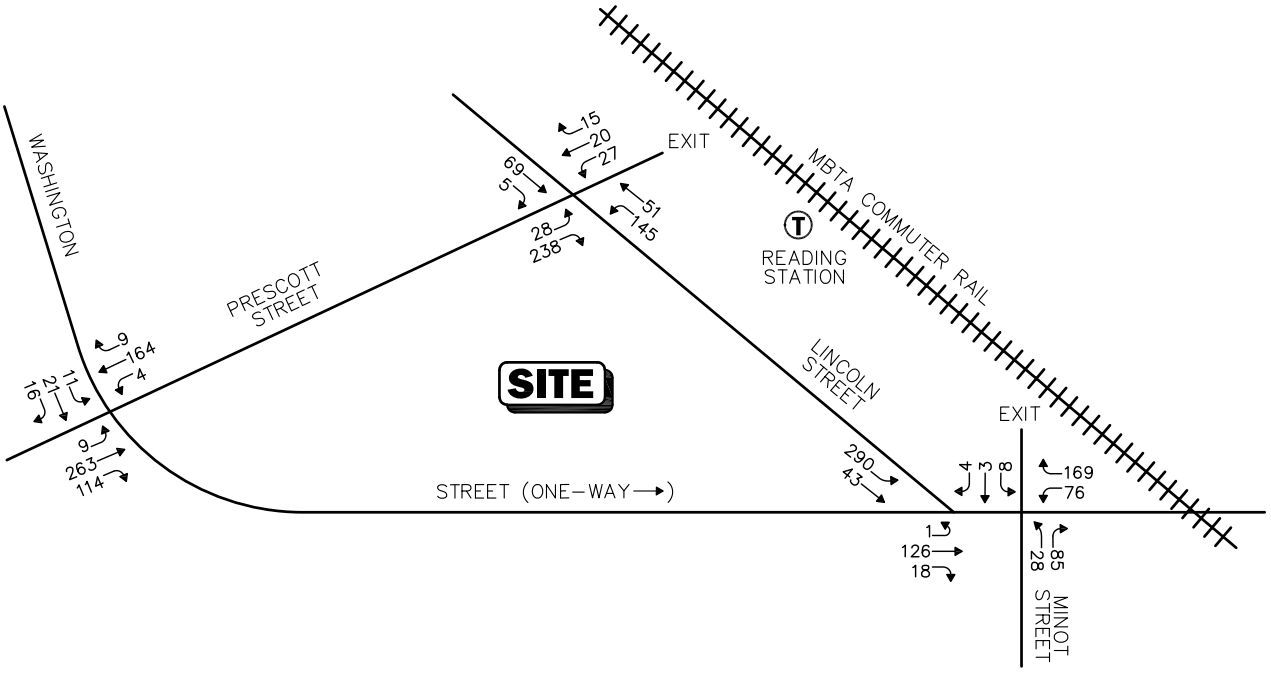

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 4

2022 No-Build
Peak Hour Traffic Volumes

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As proposed, the Project will entail the construction of a 77-unit residential apartment community. In order to develop the traffic characteristics of the Project, trip-generation statistics published by the ITE[9] for a similar land use as that proposed were used. ITE Land Use Code (LUC) 220, *Apartment*, with the independent variable of number of dwelling units equal to 77, was used to develop the traffic characteristics of the Project.

Given the proximity of the Project site to Reading Station on the MBTA Commuter Rail system and the accompanying MBTA bus lines available at the station, it is expected that a significant portion of the residents of the Project will use public transportation services, thereby reducing the volume of traffic that may be associated with the Project. In order to provide a conservative (high) analysis condition from which to assess the potential impact of the Project on the transportation infrastructure, a reduction was not applied to the base ITE traffic volume projections for the Project to reflect the use of available public transportation services.

Table 5 summarizes the anticipated traffic characteristics of the Project using the above methodology.

Table 5
TRIP GENERATION SUMMARY

Time Period/Direction	Vehicle Trips Proposed Apartment Community (77 Units)[a]
Average Weekday Daily:	
Entering	295
Exiting	295
Total	590
Weekday Morning Peak Hour:	
Entering	8
Exiting	33
Total	41
Weekday Evening Peak Hour:	
Entering	39
Exiting	21
Total	60

[a]Based on ITE LUC 220, *Apartment*.

Project-Generated Traffic Volume Summary

As can be seen in Table 5 and without reduction to account for public transportation utilization, the Project is predicted to generate approximately 590 vehicle trips on an average weekday (two-way, 24-hour volume, or 295 vehicles entering and 295 exiting), with 41 vehicle trips (8 vehicles

[9]Ibid 1.

entering and 33 exiting) expected during the weekday morning peak-hour and 60 vehicle trips (39 vehicles entering and 21 exiting) expected during the weekday evening peak-hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Reading, and then refined based on existing traffic patterns within the study area during the commuter peak periods. This methodology is consistent with the residential nature of the Project and commuter traffic patterns during the peak hours. The general trip distribution for the Project is graphically depicted on Figure 5. The additional traffic expected to be generated by the Project was assigned on the study area roadway network as shown on Figure 6.

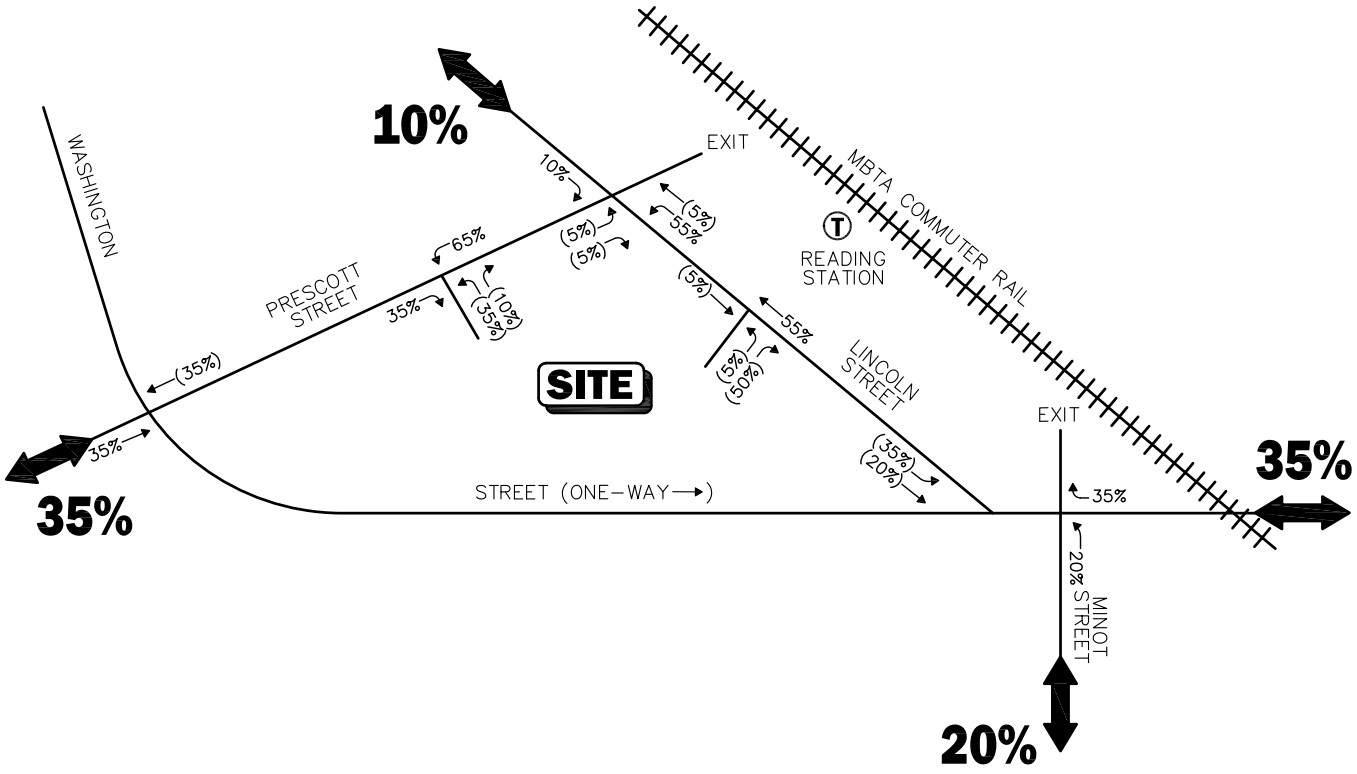
FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2022 Build condition traffic volumes consist of the 2022 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2022 Build weekday morning and evening peak-hour traffic-volumes are graphically depicted on Figure 7.

A summary of peak-hour projected traffic-volume increases external to the study area that is the subject of this assessment is shown in Table 6. These volumes are based on the expected increases from the Project.

Table 6
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2015 Existing	2022 No-Build	2022 Build	Traffic Volume Increase Over No-Build	Percent Increase Over No-Build
Prescott Street, west of Washington Street:					
Weekday Morning	469	508	523	15	3.0
Weekday Evening	522	566	587	21	3.7
Washington Street, north of Prescott Street:					
Weekday Morning	26	27	27	0	0.0
Weekday Evening	61	66	66	0	0.0
Washington Street, east of Minot Street:					
Weekday Morning	618	673	688	15	2.2
Weekday Evening	694	754	776	22	2.9
Lincoln Street, north of Prescott Street:					
Weekday Morning	231	246	250	4	1.6
Weekday Evening	158	168	174	6	3.6
Minot Street, south of Washington Street:					
Weekday Morning	221	237	244	7	3.0
Weekday Evening	236	253	264	11	4.3



Not To Scale

Figure 5

Trip Distribution Map

Vanasse & Associates, Inc.
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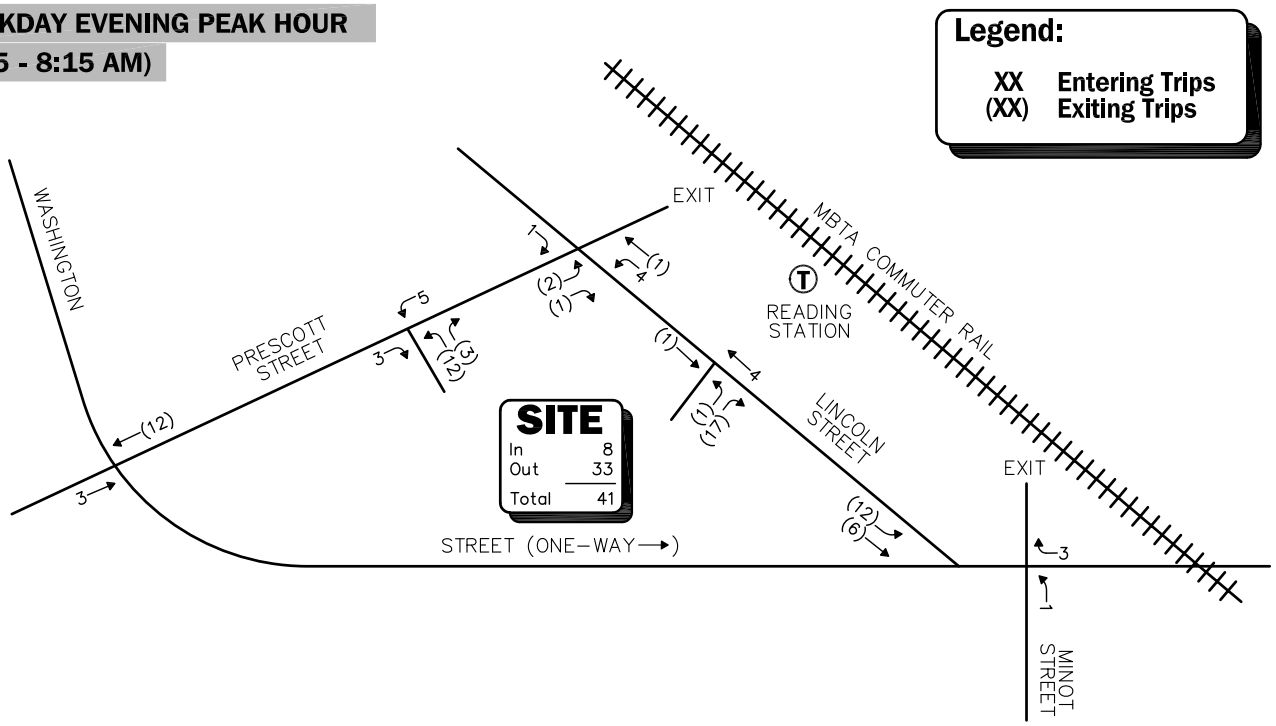
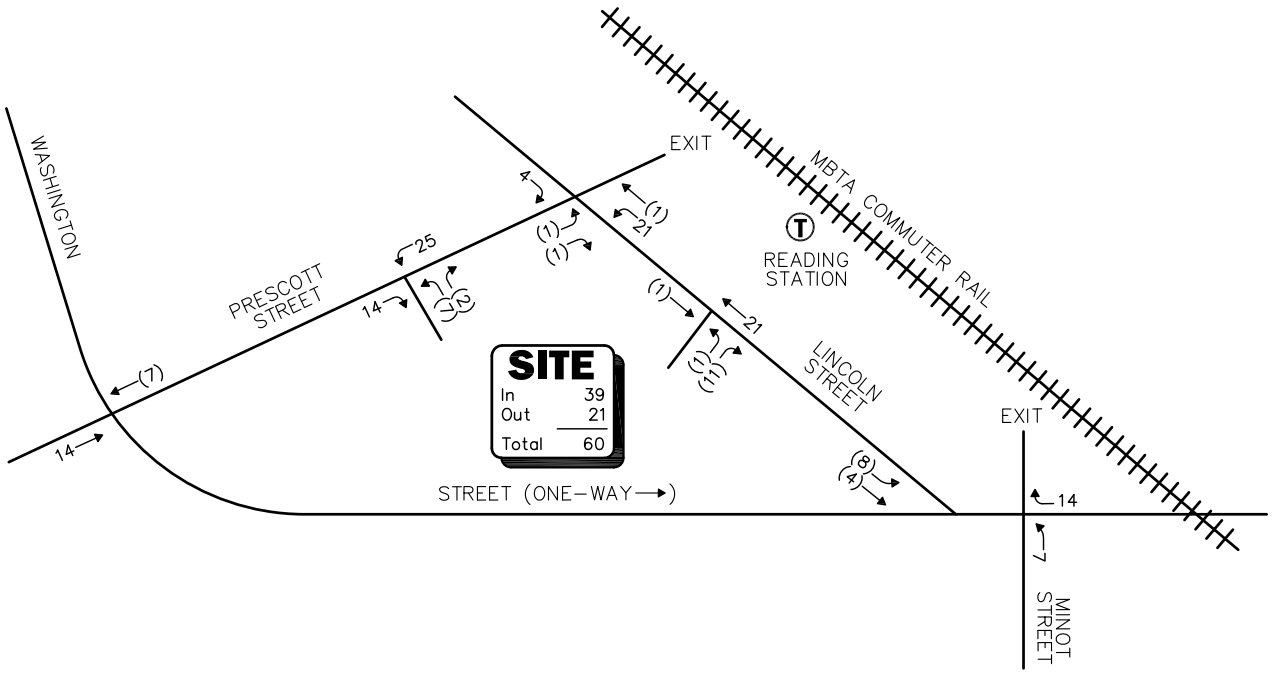
WEEKDAY EVENING PEAK HOUR
(7:15 - 8:15 AM)



WEEKDAY EVENING PEAK HOUR
(4:30 - 5:30 PM)



Not To Scale

Figure 6

Project-Generated Peak Hour Traffic Volumes

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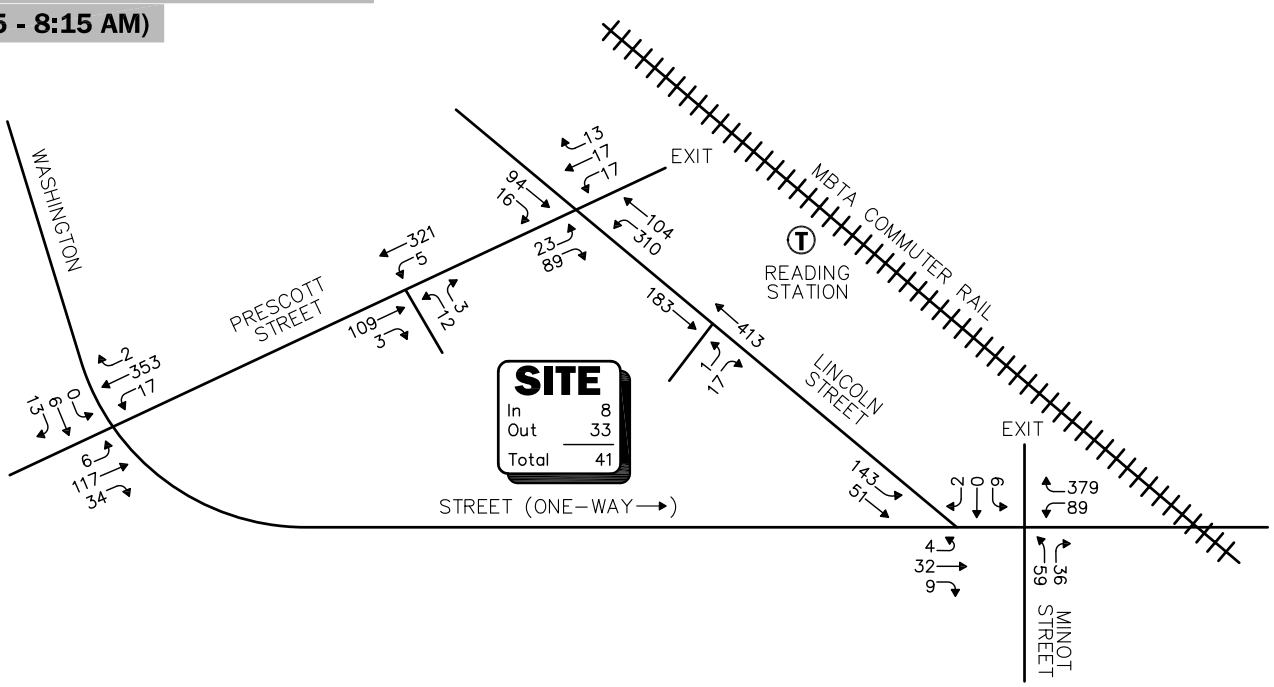
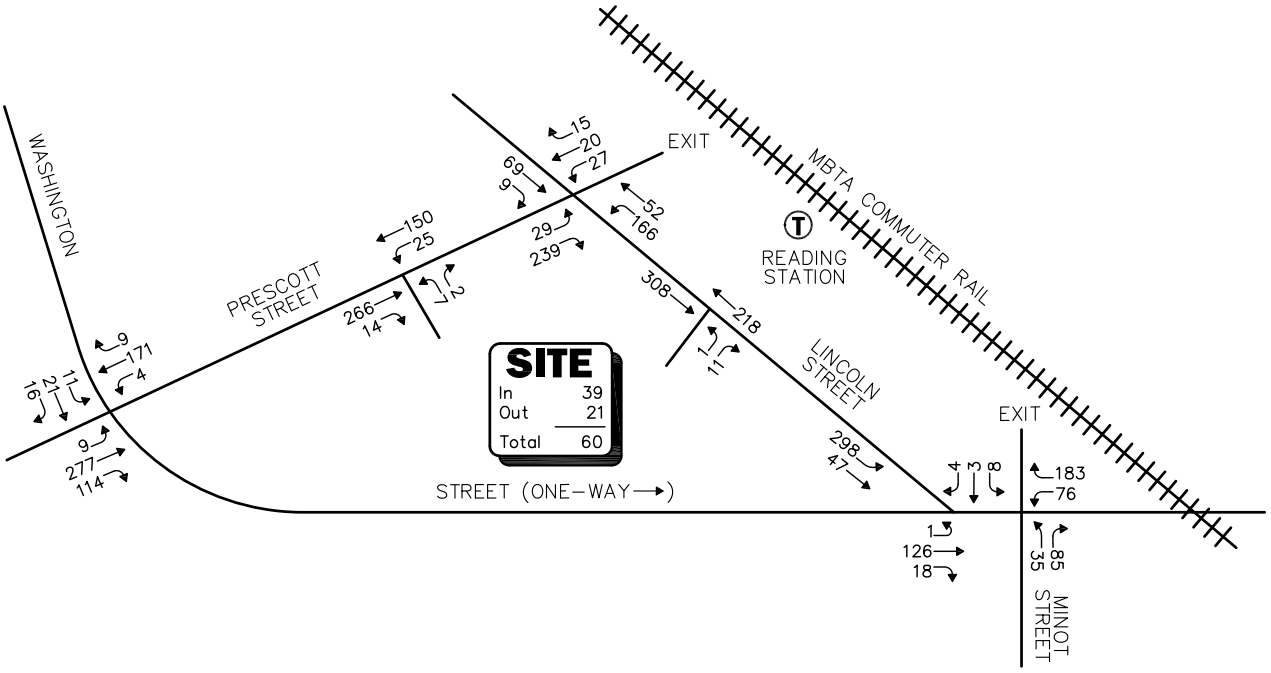
WEEKDAY EVENING PEAK HOUR
(7:15 - 8:15 AM)



WEEKDAY EVENING PEAK HOUR
(4:30 - 5:30 PM)



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 7

Vanasse & Associates, Inc.
Transportation Engineers & Planners

2022 Build
Peak Hour Traffic Volumes

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As shown in Table 6, Project-related traffic-volume increases external to the study area relative to 2022 No-Build conditions are anticipated to range from 0.0 to 4.3 percent during the peak periods, with vehicle increases shown to range from 0 to 22 vehicles. ***Such increases are considered nominal when dispersed over the peak-hour and would not result in a material impact (increase) on motorist delays or vehicle queuing outside of the immediate study area that is the subject of this assessment.***

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build and Build traffic volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[10] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

[10]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[11] Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the affects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual*. Table 7 summarizes the relationship between level of service and average control delay for two way stop controlled and all-way stop controlled intersections.

Table 7
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay
v/c ≤ 1.0	v/c > 1.0	(Seconds Per Vehicle)
A	F	≤10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

[11]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

Vehicle Queue Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro™ intersection capacity analysis software which is based upon the methodology and procedures presented in the 2010 *Highway Capacity Manual*. The Synchro™ vehicle queue analysis methodology is a simulation based model which reports the number of vehicles that experience a delay of six seconds or more at an intersection. For signalized intersections, Synchro™ reports both the average (50th percentile) the 95th percentile vehicle queue. For unsignalized intersections, Synchro™ reports the 95th percentile vehicle queue. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will be exceeded only 5 percent of the time, or approximately three minutes out of sixty minutes during the peak one hour of the day (during the remaining fifty-seven minutes, the vehicle queue length will be less than the 95th percentile queue length).

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2015 Existing, 2022 No-Build and 2022 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Table 8. The detailed analysis results are presented in the Appendix.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area.

Table 8
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2015 Existing				2022 No-Build				2022 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue 95th[d]	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Prescott Street at Washington Street												
Weekday Morning:												
Prescott Street EB LT/TH/RT	142	03	A	0	154	0.3	A	0	157	0.3	A	0
Prescott Street WB LT/TH/RT	333	0.4	A	0	360	0.4	A	0	372	0.4	A	0
Washington Street SB LT/TH/RT	18	10.2	B	0	19	10.4	B	0	19	10.5	B	0
Weekday Evening:												
Prescott Street EB LT/TH/RT	356	0.2	A	0	386	0.2	A	0	400	0.2	A	0
Prescott Street WB LT/TH/RT	163	0.2	A	0	177	0.2	A	0	184	0.2	A	0
Washington Street SB LT/TH/RT	45	11.2	B	1	48	11.7	B	1	50	11.9	B	1
Lincoln Street at Prescott Street												
Weekday Morning:												
Prescott Street EB LT/RT	101	13.8	B	1	109	14.9	B	1	112	15.6	C	1
Driveway WB LT/TH/RT	47	24.7	C	2	47	28.6	D	2	47	29.4	D	2
Lincoln Street NB LT/TH	379	6.1	A	1	409	6.2	A	1	414	6.2	A	1
Lincoln Street SB TH/RT	101	0.0	A	0	109	0.0	A	0	110	0.0	A	0
Weekday Evening:												
Prescott Street EB LT/RT	246	11.5	B	2	266	12.0	B	2	268	12.5	B	2
Driveway WB LT/TH/RT	62	17.0	C	1	62	18.6	C	1	62	20.5	C	1
Lincoln Street NB LT/TH	181	5.6	A	1	196	5.7	A	1	218	5.9	A	1
Lincoln Street SB TH/RT	69	0.0	A	0	74	0.0	A	0	78	0.0	A	0
Lincoln Street at Washington Street and Minot Street												
Weekday Morning:												
Washington Street EB LT/TH/RT	41	8.2	A	0	45	8.3	A	0	45	8.4	A	0
Washington Street WB LT/TH/RT	426	1.5	A	0	465	1.5	A	1	468	1.5	A	1
Lincoln Street SEB LT/TH/RT	162	9.8	A	1	176	10.2	B	1	194	10.5	B	2
Minot Street WB LT/TH/RT	88	16.4	C	1	94	18.3	C	1	95	19.0	C	1
Driveway SB LT/TH/RT	11	17.4	C	1	11	19.1	C	1	11	19.6	C	1
Weekday Evening:												
Washington Street EB LT/TH/RT	135	9.6	A	1	145	10.1	B	1	145	10.2	B	1
Washington Street WB LT/TH/RT	225	2.7	A	1	245	2.7	A	1	255	2.7	A	1
Lincoln Street SEB LT/TH/RT	305	12.2	B	3	333	13.3	B	3	345	14.0	B	3
Minot Street WB LT/TH/RT	105	15.3	C	1	113	16.8	C	1	120	18.6	C	2
Driveway SB LT/TH/RT	15	18.5	C	1	15	20.5	C	1	15	21.3	C	1

See notes at end of table.

Table 8 (Continued)
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/Peak Hour/Movement	2015 Existing				2022 No-Build				2022 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Prescott Street at the Project Site Driveway												
Weekday Morning:												
Prescott Street EB TH/RT	--	--	--	--	--	--	--	--	112	0.0	A	0
Prescott Street WB LT/TH	--	--	--	--	--	--	--	--	326	0.1	A	0
Project Site Driveway NB LT/RT	--	--	--	--	--	--	--	--	15	11.3	B	0
Weekday Evening:												
Prescott Street EB TH/RT	--	--	--	--	--	--	--	--	280	0.0	A	0
Prescott Street WB LT/TH	--	--	--	--	--	--	--	--	175	1.1	A	0
Project Site Driveway NB LT/RT	--	--	--	--	--	--	--	--	9	11.7	B	0
Lincoln Street at the Project Site Driveway												
Weekday Morning:												
Lincoln Street NB TH	--	--	--	--	--	--	--	--	413	0.0	A	0
Lincoln Street SB TH	--	--	--	--	--	--	--	--	183	0.0	A	0
Project Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	18	9.6	A	0
Weekday Evening:												
Lincoln Street NB TH	--	--	--	--	--	--	--	--	218	0.0	A	0
Lincoln Street SB TH	--	--	--	--	--	--	--	--	308	0.0	A	0
Project Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	12	10.4	B	0

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; SEB = southeastbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

As can be seen in Table 8, all movements at the study area intersections were shown to operate at LOS D or better during both the weekday morning and evening peak hours under 2015 Existing, 2022 No-Build and 2022 Build conditions, where an LOS of "D" or better is generally defined as "acceptable" operating conditions. Project-related impacts were identified as follows:

Prescott Street/Washington Street – No material change in operating conditions over No-Build conditions.

Lincoln Street/Prescott Street – Minor increase in motorist delay (less than 1.0 second) over No-Build conditions resulting in a change in LOS for the Prescott Street approach from "B" to "C" during the weekday morning peak-hour with no resulting increase in vehicle queuing.

Lincoln Street/Washington Street/Minot Street – Minor increase in vehicle queuing (approximately 1 vehicle) predicted to occur over No-Build conditions.

Project Site Driveways - All movements at the Project site driveway intersections with Prescott Street and Lincoln Street were shown to operate at LOS B or better during both the weekday morning and evening peak hours with no residual vehicle queuing predicted.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersections with Prescott Street and Lincoln Street in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[12] requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner. Table 9 presents the measured SSD and ISD at the subject intersections.

[12] *A Policy on Geometric Design of Highway and Streets,* 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2011.

Table 9
SIGHT DISTANCE MEASUREMENTS[a]

Intersection/Sight Distance Measurement	Feet		
	Required Minimum (SSD)	Desirable (ISD)[b]	Measured
Prescott Street at the Project Site Driveway			
Stopping Sight Distance:			
Prescott Street approaching from the east	200	--	225[c]
Prescott Street approaching from the west	200	--	500+[c]
Intersection Sight Distance:			
Looking to the east from the Project Site Driveway	200	290/335	225[c]
Looking to the west from the Project Site Driveway	200	290/335	500+[c]
Lincoln Street at the Project Site Driveway			
Stopping Sight Distance:			
Lincoln Street approaching from the north	200	--	500+[c]
Lincoln Street approaching from the south	200	--	425
Intersection Sight Distance:			
Looking to the north from the Project Site Driveway	200	290/335	500+[c]
Looking to the south from the Project Site Driveway	200	290/335	340

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*, 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011; and based on a 30 mph approach speed on both Prescott Street and Lincoln Street.

[b]Values shown are the intersection sight distance for a vehicle turning right/left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

[c]With removal of on-street parking adjacent to the Project site driveways.

As can be seen in Table 9, with the removal of on-street parking adjacent to the Project site driveways on both Prescott Street and Lincoln Street (a minimum of one (1) space on either side of the driveway), the available sight lines will exceed the recommended minimum sight distance requirements for a 30 mph approach speed along both roadways, which is consistent with the measured 85th percentile vehicle travel speed and the "prima facie" speed limit (30 mph).

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

VAI has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed construction of a 77-unit residential apartment community to be located at 2 Prescott Street and 39 Lincoln Street in Reading, Massachusetts. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

5. Using trip-generation statistics published by the ITE[13] and without reduction to account for public transportation utilization, the Project is predicted to generate approximately 590 vehicle trips on an average weekday (two-way, 24-hour volume), with 41 vehicle trips expected during the weekday morning peak-hour and 60 vehicle trips expected during the weekday evening peak-hour;

6. The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions);

7. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study intersections; and

8. Lines of sight to and from the Project site driveway intersections with Prescott Street and Lincoln Street were found to exceed the required minimum distance for the intersections to function in a safe manner based on the appropriate approach speed along both roadways with the removal of on-street parking adjacent to the driveways.

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

[13] Ibid 1.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of a full-access driveway that will intersect the south side of Prescott Street west of Lincoln Street and a one-way exit driveway that will intersect the west side of Lincoln Street. The following recommendations are offered with respect to the design and operation of the Project site driveways:

- The full access Project site driveway should be a minimum of 24-feet in width and accommodate two-way traffic. If a marked centerline is to be provided, it should consist of a double-yellow line in accordance with that the centerline pavement marking standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[14]

- The one-way exit Project site driveway should be a minimum of 16-feet in width and include appropriate signs ("One-Way", "Do Not Enter", etc.) and pavement markings to reinforce the one-way operation of the driveway.

- Vehicles exiting the Project site should be placed under STOP-sign control with a marked STOP-line provided.

- All signs and pavement markings to be installed within the Project site shall conform to the applicable standards of the MUTCD.

- Sidewalks should be provided within the Project site linking the proposed buildings and other amenities to the sidewalk infrastructure along Prescott Street and Lincoln Street.

- Marked crosswalks and wheelchair ramps should be provided for crossing the Project site driveways and at pedestrian crossings within the Project site.

- Signs and landscaping to be installed along the Project site driveways, internal to the Project site and at the Project site driveway intersections with Prescott Street and Lincoln Street should be designed and maintained so as not to restrict lines of sight.

- Snow windrows along the Project site frontage on Prescott Street and Lincoln Street within the sight triangle areas of the Project site driveways shall be promptly removed where such accumulations would exceed 2.5 feet in height.

- On-street parking should be prohibited for a minimum distance of 20-feet on either side of the Project site driveways in order to provide and maintain the required lines of sight for the driveways to operate in a safe manner.

- A school bus waiting area should be provided at an appropriate location designated by the Town.

[14] Ibid 2.

Transportation Demand Management

The Project site is ideally situated to take advantage of available public transportation opportunities, including Commuter Rail service at Reading Station which is located opposite the Project site. In an effort to the encourage use of alternative modes of transportation to single-occupant vehicles, the following Transportation Demand Management (TDM) measures will be implemented as a part of the Project:

- Information regarding public transportation services, maps, schedules and fare information will be posted in a central location;
- A "welcome packet" will be provided to new residents of the Project detailing available public transportation services, bicycle and walking alternatives, and commuter options available through MassRIDES' and their NuRide program which rewards individuals that choose to walk, bicycle, carpool, vanpool or that use public transportation to travel to and from work;
- Pedestrian accommodations will be incorporated within the Project site consisting of sidewalks and pedestrian paths linking buildings and parking to on-site amenities;
- A mail drop will be provided in a central location; and
- Secure bicycle parking will be provided, including both exterior bicycle racks adjacent to building entrances and weather protected bicycle parking in a secure area within the parking garage.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.